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Cover-- White-tailed deer (Odocoileus virginianus), are an important big game animal of hunters in northwestern Montana. Mortality and seasonal distribution of white-tailed deer in northwestern Montana and southwestern British Columbia, areas recently recolonized by gray wolves, were studied in 1990 and 1991.

Photo by Jon Rachael

ANNUAL REPORT

of the

MONTANA COOPERATIVE WILDLIFE RESEARCH UNIT

The University of Montana
Missoula, Montana

to

THE UNIVERSITY OF MONTANA

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

WILDLIFE MANAGEMENT INSTITUTE

U.S. FISH AND WILDLIFE SERVICE, DEPARTMENT OF THE INTERIOR

Volume 9
October 1991-September 1992

Respectfully submitted,

Bart W. O'Gara
Bart W. O'Gara, Leader

Ball
Joe Ball, Ass't. Leader

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MONTANA COOPERATIVE WILDLIFE RESEARCH UNIT PERSONNEL

Coordinating Committee

Don Childress, Montana Department of Fish, Wildlife and Parks, Helena
Andrew Sheldon, The University of Montana, Missoula
Bart W. O'Gara, U.S. Fish and Wildlife Service, Missoula

Unit Staff

Bart W. O'Gara, Unit Leader (Retired 6/30/92)
Joe Ball, Assistant Leader 10/1/91-6/30/92; Leader 7/1/92-9/30/92
Kerry Foresman, Division of Biological Sciences
Donald A. Jenni, Division of Biological Sciences
Zhenkui Ma, Postdoctoral Scholar
Les Marcum, Forestry School
Lee Metzgar, Division of Biological Sciences
Dan Pletscher, Forestry School
Robert R. Ream, Forestry School
Roland L. Redmond, Division of Biological Sciences
Andrew L. Sheldon, Division of Biological Sciences
Richard Taber, Forestry School
"Ginger" Schwarz, Office Manager (Retired 7/31/92)
Virginia Johnston, Secretary

Graduate Students

Tsui-lan Chen
David Felley
Kurt Forman
Randy Gazda
George Giannatos
Salah Hakim
Nathan Hall
Richard Harris
Melissa Hart
Kim Heinemeyer
Nancy Kehoe
Steve Johnsen
Claudine Leger
Yongsheng Liu
Tom Maeder
Jeff Marks
Dan Miller
Joe Moll
Alison Perkins
Jon Rachael
Dave Reiner
David Schirokauer
Mark Secord
Bill Swaney
Amjad Virk

COOPERATING AGENCIES

Fish and Wildlife Service
Montana Department of Fish, Wildlife and Parks
University of Montana
Wildlife Management Institute

Balochistan Department of Forestry
British Columbia Ministry of Forests
British Columbia Ministry of Environment, Wildlife Branch
Bureau of Agriculture, Kaohsiung, Taiwan
Bureau of Forestry, Taiwan
Council of Agriculture, Taiwan
Confederated Salish and Kootenai Tribes
Ducks Unlimited
East Kootenai Wildlife Association
Foundation for North American Wild Sheep
IBM Corporation
Idaho Department of Fish & Game
Intermountain Research Station
IUCN Office in Pakistan
Lee, Robert M.
Ministere de l'Environment (France)
Ministry of Agriculture (Greece)
National Geographic Society
National Taiwan Normal University
Northwest Plateau Institute of Biology, Xining, People's Republic of China
Office National de la Chasse (France)
Office National des Forests (France)
Pacific Cultural Foundation (Taiwan)
Parc National des Pyrenees Occidentales (France)
Plum Creek Timber Company
State of Montana
    Department of State Lands
    Flathead, Lake, and Missoula counties
The Wildlife Society, Montana Chapter
U.S. Agency for International Development (USAID)
U.S. Department of Energy
U.S. Fish and Wildlife Service
  Alaska Fish and Wildlife Research Center
  Cooperative Research Units Center
  Fish & Wildlife Enhancement, Region 6
  Grizzly Bear Recovery Coordinator's Office
  Migratory Bird Management Office
  National Bison Range
  Northern Prairie Wildlife Research Center
  Pacific/Hawaiian Islands NWR
  Prairie Pothole Joint Venture
U.S. Forest Service
  Flathead, Kaniksu, Kootenai, and Lolo national forests
U.S. National Park Service
  Glacier National Park
U.S. National Zoo's Conservation & Research Center
Wang, Y.
World Society for the Protection of Animals
Worldwide Fund for Nature (WWF)
World Wildlife Fund--U.S.

PERSONNEL NOTES

Honors and Awards Received by Unit Staff and Students

Award/Honor Received	Recipient	Reason
George Bright Memorial Scholarship	Kurt Forman Unit Student	Outstanding graduate scholastic achievement
Danny On Memorial Scholarship	Kurt Forman Unit Student	Excellence in wildlife photography
George Bright Memorial Scholarship	Melissa Hart Unit Student	Outstanding graduate scholastic achievement
Bertha Morton Scholarship Award	Jeffrey Marks Unit Student	Overall graduate level achievement
Faculty Merit Award	Roland Redmond Research Professor	Exceptional contribution to education and research at The University of Montana

The following personnel joined the Unit on nongraduate student appointments of varying length:

Canada Duck Banding and NPWRC Prairie Duck Production

- David Burt
- Jeff Gustafson
- Adam Halvorson
- Linda Hoxtell
- John Hughes
- Tom Jenni
- Shawne Leasure
- Ken MacDonald
- Greg MacHart
- William Meeks
- Amy Rath
- Carin Shoemaker
- Paul Sweet

Work Study Students

- Billie Jo Davis
- Sara Hettinger
- John Hinshaw
- Leslie Ross
- Fred Sargeson
- Georgann Zachary

Other Field and Technical Studies

Gerald Altermatt (V-S)
Dondi Dawley
Joseph Gainan (V)
Darren Johnson
Tobin Kelley
Wilma O'Gara (V)
Kevin Podruzny
Ron Righter
Don Shepard (V-S)
Rich Sonnen
Warren Tomkiewicz (V-S)
Judy Troutwine
Keith Wesley

(V) = Volunteer without subsistance allowance.
(V-S) = Volunteer with subsistance allowance.
All others are paid positions.

HE HAS DONE IT AGAIN!

Bart O'Gara (facing page) retired in June of 1992 after 24 years at the Montana Wildlife Unit. Following his earlier retirements, from high school in 1939, and the US Navy in 1960, Bart completed his Ph.D. and joined the Montana Unit as Assistant Leader in 1968. He succeeded John Craighead as leader in 1978.

Bart's contributions to science, education, wildlife, and people speak for themselves. He will be missed greatly around the Montana Wildlife Unit, and we all wish him well in new pursuits.

NOT TO BE OUTDONE...

"Ginger" Schwarz retired in July of 1992 after 20 years as Unit Secretary. "Ginger's" long-term commitment to the Unit and its people is greatly appreciated. Her honorary namesake, a mild-mannered female grizzly bear, still roams the mountains of western Montana.

Photo by Jon Rachael

ABSTRACTS

Mortality and Seasonal Distribution of White-tailed Deer in an Area Recently Recolonized by Wolves

Project Leader:	D. Pletscher
Student:	J. Rachael
Cooperators:	USFWS: Region 6 Fish & Wildlife Enhancement; British Columbia Wildlife Branch; USFS: Flathead National Forest; NPS: Glacier National Park; and Montana Department of Fish, Wildlife and Parks

Results:

After an absence of 50 years, gray wolves (Canis lupus) began recolonizing northwestern Montana in the mid-1980's. Wolf recolonization is controversial and the public has expressed concern about the potential impacts a wolf population may have on native ungulate populations. White-tailed deer (Odocoileus virginianus) are an important big game animal of hunters in northwestern Montana, and are also the major prey species of wolves. Between January 1990 and September 1991, I examined mortality and seasonal distribution of white-tailed deer in the North Fork drainage of the Flathead River in northwestern Montana and southeastern British Columbia. I also initiated an index to monitor deer population abundance over time, estimated the sex- and age-composition of the population, and examined habitat used by does during the fawning period.

Of 38 female white-tailed deer radio-collared during the study, wolves, bears (Ursus arctos and U. americanus), mountain lions (Felis concolor), coyotes (C. latrans), and humans each killed 2. Exact cause of death of 2 other deer could not be determined. Mean annual survival rate of marked females was 72.5%. Survival was highest during summer (100%) and autumn (94.9%), and lowest during spring (85.9%) and winter (89.0%). Deer congregated on 4 primary ranges during winter, and migrated an average of 11.7 km (range = 0-40 km) to summer ranges that were scattered throughout the North Fork valley and up 3 side drainages. I initiated an index of pellet group counts that will permit biologists to detect a 20% change in deer population size with 90% certainty. Based on road-side surveys I conducted in 1990 and 1991, I estimated a spring herd composition of 24-29 bucks:100 does, and 35-36 fawns:100 does.

Does selected fawning areas that were at significantly lower elevations and closer to water than summer ranges. Fawning areas contained significantly fewer saplings, had less hiding cover between 1-2 m height (as viewed from 30.5 m), were more likely to occur in valley bottoms, and were more likely to contain edges than summer ranges. Deer also selected fawning and summer ranges differently based on distribution of canopy coverage of grasses and trees larger than pole-size, and distribution of vegetation structural class.

STUDENT RESEARCH PROJECTS

Status and Demography of the Bristle-thighed Curlew

Project Leaders:	R. Redmond and J. Ball
Student Investigator:	J. Marks
Cooperators:	U.S. Fish & Wildlife Service, Pacific/Hawaiian Islands NWR, Alaska Fish and Wildlife Research Center and Cooperative Research Units Center; National Geographic Society; World Wildlife Fund

Objectives:

1. Describe molt by age class, including timing, duration, and pattern of feather replacement;
2. describe molt-induced flightlessness, including duration of the flightless period and habitat use during flightlessness, and estimate the proportion of adults that becomes flightless;
3. assess the influence of sunlight (i.e., UV radiation) on the fading and wear of curlew primaries;
4. determine the timing of spring and autumn migration and describe migratory behavior;
5. estimate migratory flight ranges;
6. determine if Laysan is a major stopover for migrating curlews and whether curlews spend the winter on Laysan after completing molt there in autumn;
7. determine annual survivorship by age class and age of first breeding; and
8. determine spatial use patterns (i.e., territoriality and home range use) by age class and among years.

Results:

Our visit to Midway Atoll (621 km WNW of Laysan Island) from 23 to 30 April 1992 concluded our field work on bristle-thighed curlews (Numenius tahitiensis) in the Northwestern Hawaiian Islands. The main objective was to obtain mensural data from ≥ 30 adult curlews that would allow us to estimate migratory flight ranges based on the methods of Pennycuick (1989, Bird flight performance, Oxford Univ. Press, Oxford). We also collected three adult curlews for analysis of fat content and obtained data on nocturnal communal roosting, curlew numbers on the atoll, diurnal habitat use, and diurnal flocking behavior.

Midway Atoll consists of three islands. Sand Island, the largest of the three, is inhabited by people and includes a U. S. Navy airfield. On several evenings in 1991, refuge biologist Don Williamson observed flocks of curlews leaving Sand Island and flying toward tiny Spit Island (approx. 4 ha) 1 km away. He surmised that most of the curlews using Sand Island during daytime spent the night on Spit Island. His suspicions were confirmed when refuge volunteers counted from 30 to 96 curlews flying between Spit and Sand islands at dawn and dusk on five days between 15 February and 15 March 1992.

We observed curlews flying between Sand and Spit islands on four evenings and three mornings from 23 to 29 April 1992. We recorded a maximum count of 100 individuals arriving at Spit Island on the evening of 26 April. Curlews left Sand Island up to 1 hr and 15 min before sunset and continued to arrive on Spit Island for at least 20 min after sunset. Most of the morning departures from Spit Island occurred shortly before sunrise. Flock sizes were larger in the morning than in the evening. The largest flocks appeared to fly directly to a roosting site on the air taxiway adjacent to the water catchment basin on Sand Island.

In the evening, all of the curlews flew to the same small area (approx. 0.5 ha) near the south end of Spit Island. The curlews roosted communally and apparently moved little during the night (we found concentrations of droppings and feathers and saw only one set of curlew tracks on the beach). This contrasts with our observations at Laysan, Lisianski, and Tern islands, where bristle-thighed curlews do not roost communally at night. As noted previously by refuge personnel, we found that virtually all of the atoll's curlews inhabited Sand Island during daytime. We also confirmed previous suspicions that most of these curlews spend the night on Spit Island. The curlews probably do not forage at night on Spit.

Why do curlews leave Sand Island for the night? The most obvious explanation is that they are avoiding people. Spit Island is uninhabited, whereas approximately 200 people currently reside on Sand Island. Even though people do not now harass the curlews, it is possible that the birds were harassed in the past when up to 5,000 people lived on Sand Island.

We caught 37 curlews during two nights of trapping on Spit Island. Because we strived to catch many birds in as short a time as possible, we did not color band all of the birds that we caught; 13 curlews were uniquely color banded on their tibiotarsi. Three adults (two males, one female) were collected for determination of fat content; the specimens were shipped to the Gaylord Memorial Laboratory at the University of Missouri for analysis. Based on plumage wear and molt, two of the birds captured were second year (SY), two were third year (TY), and 33 were after third year (ATY). Both SYs were replacing primaries, and both TYs had two generations of fully grown primaries. All but two of the ATYs weighed more than 600 g (mean = 683.6 g, SD = 54.1, range = 580-781 g). The SYs weighed less than 500 g and clearly had not taken on large fat stores. The TYs, which weighed 547 and 553 g, had moderate fat stores that probably were inadequate for migration to Alaska. It was our impression that more than 75% of the curlews residing at Midway were ATYs.

In addition to taking standard measurements, we measured wing span and body frontal area (Pennycuick 1989). A regression analysis of wing chord (WC) and wing span (WS) yielded an r value of 0.893 ($P < 0.0005$) for 33 ATYs. Wing span (in mm) may be estimated by the following formula:

$$WS = WC(2.713) + 192.033.$$

A regression analysis of body mass (M) and body frontal area (BFA) for the 33 ATYs yielded an r value of 0.584 ($P < 0.0005$). A rough estimate of body frontal area (in mm) can be obtained from:

$$BFA = M(0.079) + 197.356.$$

On 29 January 1992, refuge personnel counted 95 bristle-thighed curlews during a complete survey of Sand Island, very close to our maximum count of 100 birds at Spit Island on the evening of 26 April. We estimate that between 100 and 125 curlews resided on Midway Atoll during the winter of 1991-92. Intensive color banding and mark-resighting analyses are needed to estimate more accurately the number of curlews using the atoll.

Bristle-thighed curlews occupied most of the habitats on Sand Island. During our visit, we saw the largest numbers of birds (up to 30 in one morning) in grasslands (viz., the antenna fields and golf course fairways) and open ironwood forest with a grass/forb understory. Several solitary birds were also seen in dense ironwood forest. Foraging activity was intense in the grass and open ironwood habitats, with the birds apparently feeding on small invertebrates. The only prey items that we identified were large grubs of an exotic beetle. We did not see any curlews or curlew tracks on the beach at Sand Island. Judging by the number of burrows, ghost crab (Ocypode laevis) numbers seemed to be much lower at Midway than at Laysan Island, perhaps explaining the lack of curlew activity on the beaches at Midway.

During the afternoon, curlews gathered in large flocks on the air taxiway and the adjacent water catchment basin at Sand Island. We counted 45 curlews there on 26 April, 96 on 27 April, and 86 on 29 April. Most of the individuals in these flocks were roosting, although a few birds foraged in the grassy strips between the pavement and drank fresh water from the catchment basin. So far as we know, curlews did not migrate from the atoll during our visit. Because most adult curlews migrate from Laysan during the first 10 days of May, we expect that the Midway birds were close to migrating when we left the atoll on 30 April. Large flocks typically occur at the catchment basin only during spring (D. Williamson, pers. comm.), suggesting that this area serves as a staging site for migrating curlews.

Options for Wildlife Conservation in Yeniu Gou (Wild Yak Valley), Qinghai Province, People's Republic of China

Project Leader:	B. O'Gara
Student Investigator:	R. Harris
Cooperators:	Northwest Plateau Institute of Biology, Xining, People's Republic of China; Robert M. Lee

Objectives:

1. Estimate densities of the seven wild ungulate species inhabiting Yeniu Gou;
2. determine habitat and food preferences of the seven ungulate species;
3. delineate the major obstacles to effective conservation of these and other species in Yeniu Gou; and
4. investigate the feasibility of generating funding from foreign sources to aid conservation in Yeniu Gou.

Results:

Continuing wildlife surveys were conducted in Yeniu Gou (Wild Yak Valley) from 6 August through 29 August 1992. Observations and numbers of wild yak (Bos mutus), Tibetan wild ass (Equus hemionus), Tibetan gazelle (Procapra picticaudata), Tibetan antelope (Pantholops hodgsoni), blue sheep (Pseudois nayaur), argali (Ovis ammon), and white-lipped deer (Cervus albirostris) were recorded for comparison with 1991's census results and for development of standardized population estimation procedures. Preliminary analyses of 26 collections of fecal material were completed, and suggested considerable overlap in dietary preferences among the seven ungulate species. An additional five collections were made to supplement these data, and micro-histological fragment analysis is currently being conducted in Colorado.

Informal interviews were conducted with most of the ethnic Mongol pastoralists summering livestock in Yeniu Gou, and information on their patterns of use elucidated. Discussions were held with local authorities in Golmud City regarding potentials and problems associated with opening Yeniu Gou to international big-game hunting.

The initial mailing of questionnaire surveys on the potential for generating conservation funding through nature travel and/or trophy hunting was completed. Response rate was 58% (although a few nonrespondents provided detailed information verbally), and follow-up questions and detailed analyses are continuing.

Integration of Wildlife Conservation with Community Development in the Yushan National Park in Taiwan--A Case Study

Project Leaders: C. Servheen and B. O'Gara

Student Investigator: Tsui-Lan Chen

Cooperators: Y. Wang, National Taiwan Normal University; Council of Agriculture, Taiwan; Bureau of Agriculture, Kaohsiung, Taiwan; Bureau of Forestry, Taiwan

Objectives:

1. Identify the social-cultural and economic factors that cause conflicts between local wildlife resource utilization and park conservation;
2. summarize the relationship between wildlife marketing and the aboriginal economic culture;
3. describe the attitude of local people toward law enforcement by the Park police force within and around the Park;
4. assist the local government and park managers to develop a management plan for multiple utilization of local wildlife resources; and
5. develop education programs in target aborigine villages for better cooperation with local villagers.

Results:

The student investigator worked in the field from September 1991 through November 1992. Data were collected through participant observation in 3 villages, interviews were conducted with 120 local people, and mail surveys were done with 75 village representatives and 510 forest-station workers.

Participant observation was carried out in 3 major aboriginal villages (Sanmin, Taoyuan, Chochi). These villages were randomly selected from 7 aboriginal villages. Malayan-speaking hunters in these villages were identified and intensive interviews with them were conducted. In total, 120 people in the 3 villages were interviewed, including 68 professional or amateur hunters.

Village representatives were selected from 13 out of 30 townships. Seventy-five village representatives were selected and questionnaires were mailed to them individually; 28 had responded after 2 months with a response rate of 37.3%.

The number of questionnaires sent to forest-station workers was proportional to the percentage of workers in each station, usually ranging from 10 to 15. Totally, 510 questionnaires were sent out; 274 were collected with a response rate of 53.7%. Detailed results of the study are being analyzed.

Balancing Wildlife Conservation with Local Economic Development through Community-based Projects in Balochistan, Pakistan

Project Leader:	D. Pletscher
Student Investigator:	A. Virk
Cooperators:	The University of Montana; Department of Forestry, Balochistan; U.S. Agency for International Development (USAID); IUCN Office in Pakistan

Objectives:

1. Examine land-use practices of local communities;
2. determine the extent to which local people use wild species, and the purpose of that use;
3. examine whether or not local communities are aware of economic and recreational values of wildlife species found in their areas;
4. determine the attitudes of local people toward wildlife and its conservation; and
5. estimate trends in wild ungulate populations in the community-based conservation areas.

Results:

During summer 1992, the student investigator visited several local communities in Balochistan and northern areas of Pakistan. He discussed the prospects of community-based wildlife conservation projects with various community leaders, government agencies, and local NGOs (Non-government organizations). Based on his discussions and findings, a detailed study plan has been developed that would include 3 years of field work starting in autumn of 1993.

Bear Habitat Evaluation in the Pyrenees

Project Leader:	C. Servheen
Student Investigator:	Claudine Leger
Cooperators:	Ministere de l'Environnement (France); Office National de la Chasse (France); Office National des Forets (France); Parc National des Pyrenees Occidentales (France)

Objectives:

1. Evaluate bear habitat quality in an area of about 100,000 ha in the Pyrenees, centered on the actual bear range; and
2. define and quantify the factors responsible for the bear population extinction.

The following methods will be used:

1. Build the database of a cumulative effects analysis model by gathering data on human activities and natural components within the study area; and
2. use this database in a Geographic Information System (Arc Info) to look at the evolution of landscape features (natural and human-related) through time, and to compare areas with and without bears.

Results:

Once the factors negatively impacting the bear population are defined, a scoring system aiming at evaluating each pixel on a map of the study area will be created. The final output will consist of a map presenting areas of high importance for the recovery of the bear population.

The student is currently taking classes. The month of July 1993 will be spent in the Pyrenees to determine what data will be available and purchase data from SPOT (Satellite Probatoire d'Observation de la Terre). A final proposal will be written during the fall of 1993. Data collection should start during the summer of 1994.

Seasonal Range and Habitat Selection by White-tailed Deer in Northwestern Virginia

Project Leader:	B. O'Gara
Student Investigator:	S. Hakim
Cooperators:	National Zoo's Conservation and Research Center, Front Royal, Virginia

Objectives:

1. Determine seasonal home-range size and distribution relative to habitat;
2. compare seasonal habitat selection of deer;
3. identify variables that influence such selection and look at seasonal changes;
4. determine if seasonal activity patterns are related to home range size or forage available;
5. describe family interactions and group size; and
6. estimate population structure.

Results:

The student is revising the first draft of his dissertation and is expected to submit final copy during Autumn Semester 1993.

Movements and Ecology of Wild Yaks in Qinghai Province, People's Republic of China

Project Leader:	B. O'Gara
Student Investigator:	D. Miller
Cooperators:	Robert M. Lee; Northwest Plateau Institute of Biology, Xining, People's Republic of China

Objectives:

1. Classify vegetal and structural characteristics of wild yak habitat in Qinghai Province;
2. determine population characteristics (density, movements, sex ratio, age structure) for wild yaks in the intensive study area;
3. determine seasonal habitat selection and use, seasonal food habits, and activity patterns for wild yaks; and
4. assess range condition trends and competition between wild yaks and domestic livestock for forage.

Results:

The student investigator is working in Asia and will return to school and research in 1994.

Pheasant Recruitment and Survival in Southcentral Idaho

Project Leader:	J. Ball
Student Investigator:	T. Maeder
Cooperators:	Idaho Department of Fish and Game

Objectives:

1. Evaluate pheasant recruitment in southcentral Idaho;
2. estimate survival of hen pheasants during the spring-summer reproductive period;
3. integrate information from objectives 1 and 2 to produce a simple recruitment model;
4. evaluate recruitment and survival of wild introduced pheasants compared to indigenous pheasants;
5. describe the vegetative types used by nesting and brooding pheasants, and the relationship between habitat and recruitment; and
6. identify mortality factors limiting pheasant populations in southcentral Idaho.

Results:

Student Investigator has completed all field and course work, has accepted a position with Idaho Department of Fish and Game, and is expected to complete thesis in 1993.

Influence of Skunk Removal on Nest Success and Breeding Populations of Upland Nesting Ducks in the Lower Flathead Valley

Project Leader:	I. J. Ball
Student Investigator:	K. Forman
Cooperators:	National Bison Range, Montana Department of Fish, Wildlife and Parks, Confederated Salish and Kootenai Tribes, Ducks Unlimited.

Objectives:

1. Determine the importance of skunk densities to nest success of upland nesting ducks;
2. monitor nest densities and population trends of ducks relative to success during previous years;
3. evaluate the long-term effectiveness of skunk removal on duck populations; and
4. develop nonlethal alternatives for maintaining low skunk densities.

Results:

Skunk populations, as monitored by trapping success (captures/1000 trap nights) have declined steadily since trapping began (15, 10, 5, 5, 3). Duck nest success at Ninepipe increased substantially from baseline when skunks were removed (23% to 44%). Nest success did not increase at the Pablo control area (24% to 18%). Number of hatched nests per 100 ha of managed cover at Ninepipe increased from 15 in 1986 to 122 in 1992. The number of dabbling duck pairs surveyed on standardized area at Ninepipe increased from a 1982-1988 average of 234 to 753 in 1992. Mean 1991-1992 number of breeding pairs per hectare of surface water at Ninepipe (12.9) was among the highest ever recorded in glaciated wetland habitat.

The thesis will be completed in spring of 1993.

Effects of Nest Predators on Ground-nesting Bird Communities in Northwest Montana

Project Leader:	D. Pletscher
Student Investigator:	W. Swaney
Cooperators:	USFWS: Cooperative Research Units Center, Region 6, and Prairie Pothole Joint Venture; Confederated Salish and Kootenai Tribes; Ducks Unlimited

Objectives:

1. Describe distribution, abundance, and species composition of nesting bird communities relative to habitat type and cover density; and
2. quantify nest success of the most common non-waterfowl bird species in relation to habitat quality and predator populations.

Results:

In the Ninepipe skunk removal area, 395 ha were searched 3 times between 14 April and 26 June 1992, while 100 ha were searched in the Pablo control area. I found 111 nests at Ninepipe, including 57 short-eared owls, 19 western meadowlarks, 12 northern harriers, 10 ring-necked pheasants, 6 common snipe, 3 killdeer, 2 Wilson's phalaropes, 1 American bittern, and 1 sora. I found 12 nests at Pablo, including 5 ring-necked pheasants, 3 western meadowlarks, 1 short-eared owl, 1 northern harrier, 1 savannah sparrow, and 1 sora.

The most numerous species in the Ninepipe area experienced high rates of apparent nest success. Of the 57 short-eared owl nests, 20 had already hatched when they were found, 30 eventually hatched, and 7 were depredated. For the 2-year study, I used 44 owl nests in nest success calculations, and apparent hatching success was 75% (50.3% Mayfield). Of the 19 western meadowlark nests, 3 were hatched when they were found, 12 eventually hatched, 3 were abandoned due to investigative disturbance, and 1 was of unknown fate. For both years of the study, apparent hatching success for meadowlarks was 74.2% (57.2% Mayfield). Of the 12 northern harrier nests found, 10 eventually hatched, while the remaining 2 were depredated, as was the lone harrier nest found in 1991. Apparent hatching success for harriers in 1991-92 was 76.9% (68.9% Mayfield). Of the 6 common snipe nests, 4 eventually hatched and 2 were depredated. During the 2-year study, 10 snipe nests hatched and 2 were depredated. Apparent hatching success was 83.3% (71.3% Mayfield).

Killdeer and phalarope experienced the lowest rates of hatching success of the more numerous species found on the Ninepipe study area. For both years of the study, 3 phalarope nests hatched and 4 were unsuccessful (apparent success 42.8, Mayfield 16.2%), and 1 killdeer nest hatched while 2 were unsuccessful (apparent success 33.3%, Mayfield 28.2%).

Total nest numbers between the 2 areas were so skewed as to make comparison difficult between the 2 areas. For the 2 years of the study, I found 200 nests at Ninepipe and only 25 nests at Pablo. The most numerous species at Pablo were ring-necked pheasant and western meadowlark with 5 nests each. Of the 5 meadowlark nests, 2 hatched, 2 were hatched when they were found, and 1 was of unknown fate. Two of the pheasant nests hatched, 2 were eventually depredated, and the remaining nest, located near the water's edge, was damaged by nest dragging equipment and was eventually flooded. I found 3 short-eared owl nests, 2 of which were hatched when they were found, and the remaining nest eventually hatched. Three killdeer nests found were unsuccessful. Three savannah sparrow nests were found, 2 of which hatched and the remaining nest was hatched when it was found. I found 2 snipe nests, of which 1 hatched and the other was eventually depredated, and a single nest each of spotted sandpiper, vesper sparrow, sora, and northern harrier, all of which eventually hatched except the harrier nest, which was eventually depredated. With such a small sample size at Pablo, Mayfield estimates of nest success will have such large confidence intervals as to be nearly meaningless.

In 1992, I recorded all species of birds flushing from the cable during nest searches, regardless of whether the nest was located or not. Recording was done during the third nest search of the year, and indicated many more pheasant broods than what my nest numbers for pheasants would indicate. In the Ninepipe area, I recorded 42 brood flushes and 31 individual pheasant flushes. I also recorded the flushing of 10 meadowlarks, 10 sparrows (most likely either vesper or savannah), 1 gray partridge, 1 avocet brood, 1 killdeer brood, and 1 phalarope brood. In the Pablo area, I recorded 2 pheasant broods and 1 gray partridge brood, 1 pheasant, 1 gray partridge, 14 sora, and 14 sparrows (including vesper, savannah, and grasshopper).

Numbers from these flush counts show that more birds are nesting than my nest searches are indicating, and that nest search methods should be evaluated in the event of future research in the area. Possible suggestions would be intensive searches on foot using rope drags and several observers following behind, or modifications of methods currently being used in this study. In either case, future research should include an estimation of fledging success as well as hatching success, since hatching success was the primary emphasis in this study. It should be noted that fledging success cannot be calculated for precocial birds such as killdeer, snipe, or pheasants, but could be calculated for birds such as meadowlarks, harriers, and short-eared owls. The methods for calculating fledging success for short-eared owls must take into account the fact that the young disperse away from the nest as they grow older. Future research on owl nestlings could incorporate a set period (for example, 7 days) as an estimator of fledging success, since after about this age, nestlings begin to disperse out away from the nest and would be difficult or impossible to find.

Movements, Activity, and Habitat Use of Reintroduced Fishers in Northwestern Montana

Project Leader:	K. Foresman
Student Investigator:	K. Heinemeyer
Cooperators:	Montana Department of Fish, Wildlife and Parks; USFS: Kootenai National Forest; The Wildlife Society, Montana Chapter

Objectives:

1. Determine the short-term success of the effort to reestablish fishers in the Kootenai National Forest;
2. examine the effectiveness of soft release vs. hard release procedures in translocating fishers; and
3. examine colonization ecology through temporal changes in movements, activity, spacing, habitat use, and mortality.

Results:

Seventy-eight fishers were released into the Cabinet Mountains of northwestern Montana between October 1990 and October 1991. All were live-trapped in Wisconsin and transported to Montana via covered truck. Thirty-eight and 40 fishers were released into the Cabinet Mountains in 1990 and 1991, respectively. In 1990, 24 of the animals were radiotagged (5 surgically implanted with temperature-sensitive transmitters and 19 fitted with collars). Of these, 12 were soft-released and 12 were hard-released to examine the effect of release techniques on movements and survival. All of the untelemetered animals from 1990 and 1991 were hard-released.

The 24 radiotagged fishers, as well as 2 to 7 collared fishers from a previous release (1989) were located from the ground or from fixed-wing aircraft every 2-5 days from October 1990 through September 1991. Additionally, the 1989 fishers had been monitored since June 1990. The locations will be used to examine movements, spacing, and habitat use. Twenty-four hour remote activity monitoring conducted throughout the field season will provide data on daily activity patterns, seasonal activity levels, and body temperature regimes (for the implanted animals. Data analysis and write up is expected to be completed by May 1993.

International Hunting and Its Local Involvement, Qinghai, Peoples Republic of China

Project Leader:	B. O'Gara
Student Investigator:	Y. Liu
Cooperators:	Robert M. Lee; NW Plateau Institute of Biology, Chinese Academy of Sciences, PRC

Objectives:

1. Investigate the decision-making process that led to the establishment of Dulan International Hunting Area;
2. determine economic incentives and disincentives to local people involved in the international hunting package;
3. describe the attitudes of local people toward the International Hunting Program; and
4. evaluate the positive and negative impacts this program has on local wildlife management and conservation.

Results:

The first field season inventory was implemented from 10 July through 11 September 1991. Baseline information was collected by using open-ended questionnaires, and a general feeling of the circumstances of the study area obtained.

The second field season was conducted from 15 August to 25 September 1992. Key informants in conservation agencies and local people around the two hunting campsites were interviewed. Direct observations were carried out at the two hunting camps. Most of the key informants interviewed acknowledged substantial profit (> 100%) made from the international hunting program and have expressed willingness to use the revenue from the program to promote local wildlife management and conservation. More than 65% of the local people interviewed around the two hunting sites indicated support for the international hunting program because they can realize monetary and other benefits from the program. Those families directly involved in the program can receive 5-10% of their annual family income through renting horses, serving as game guides, providing labor at the camps, etc. Other benefits for local communities include investment by hunting agencies to improve road conditions to the hunting camps (thus local herders benefit indirectly), and medical services provided to those near the hunting camps during the two hunting seasons (April to May and August to October). Poaching of red deer (*Cervus elaphus*), white-lipped deer (*Cervus albirostris*), and other economically important species has decreased since establishment of the hunting area.

Nest Success of Ground-nesting Birds at Sterling Wildlife Management Area

Project Leader:	J. Ball
Student Investigator:	R. Gazda
Cooperator:	Idaho Department of Fish and Game

Objectives:

1. Develop a habitat map for the Sterling WMA;
2. gather baseline data on the Mayfield nest success of ground-nesting birds;
3. determine if nest predation is a problem for ground-nesting birds on Sterling WMA; and
4. determine if nest density and success differ by habitat or distance from Russian olives.

Results:

Nest success has long been considered the most important factor affecting recruitment in upland nesting ducks. Little is known about the nesting success of ground-nesting birds in much of the Intermountain West. The impact of Russian olives, which have recently spread throughout the Intermountain West, on native wildlife is also not well understood. Much of the Sterling WMA has been invaded by Russian olives in the last 40 years. This coupled with signs of low nest success prompted the current study.

Field work was conducted at Sterling between 15 April and 25 August 1992. Field work was conducted to gather data on ground-nesting birds and their predators. A total of 79 active magpie nests were located and mapped. Three habitat types were selected and 10 scent stations placed in each. These stations were operated for 5 days in both June and July. Nest searches were conducted between 29 April and 10 July. A total of 179 duck and 16 other nests were located. Of the 179 duck nests, 55% were mallards and the remainder was made up of northern pintails, northern shovelers, gadwalls, cinnamon and blue-winged teal, lesser scaup, and redheads. Overall Mayfield nest success for ducks was 7.7%. This is well below the 15% Mayfield nest success suggested as a minimum for population maintenance. Distance to nearest Russian olives and density of Russian olives within a 50-m radius was also measured for each nest. This and other data is being summarized and analyzed.

Ring-necked Pheasant Recruitment and Survival in Southwestern Idaho

Project Leader:	J. Ball
Student Investigator:	D. Felley
Cooperator:	Idaho Department of Fish and Game

Objectives:

1. Estimate hen survival;
2. estimate hen success and nest success;
3. estimate brood survival;
4. integrate information from objectives 1, 2, and 3 to produce a simple recruitment model;
5. describe habitat types used for nesting and brood rearing, and describe the relationship between habitat and recruitment; and
6. identify mortality factors limiting pheasant populations.

Results:

A recruitment study of ring-necked pheasants (Phasianus colchicus) was carried out in 1990 and 1991. A total of 106 hens were radio-tagged. Eighteen hens were lost, 30 hens removed their radios, and 39 hens were known to have died. Predation was the cause of death in 93% of the cases where cause was known. Hen survival was significantly different between years; 0.6005 in 1990 and 0.4347 in 1991. Fifty-six nests were found, and nest success was 0.558, not significantly different between years. Of 55 hens entering the breeding season, hen success was 0.527, not significantly different between years. Brood survival differed greatly between years. Of 14 broods in 1990, only 1 was known to have failed, while 8 out of 15 were known to have failed in 1991. A preliminary estimate of brood survival for the first 8 weeks is 0.89 for 1990 and 0.22 in 1991. Decreased brood survival in 1991 was due to mortality of 6 hens. Use-availability of nesting cover showed that permanent cover and small grains were selected and sagebrush was avoided. Nest success in permanent cover was the lowest of all cover types but nest success in small grains was second best of all cover types. The most important population parameters of consideration in this population are hen survival and brood survival.

Production and Habitat Selection of Ground-nesting Birds at Freezeout Lake Waterfowl Management Area

Project Leader:	J. Ball
Student Investigator:	A. Perkins
Cooperators:	U.S. Fish & Wildlife Service; Montana Department of Fish, Wildlife and Parks

Objectives:

1. To develop a detailed and accurate habitat map of Freezeout Lake WMA;
2. estimate the density and success of ground-nesting birds at Freezeout Lake WMA.
3. determine total duck production for the area;
4. evaluate nest-site vegetation characteristics in relation to success; and
5. evaluate nest distribution and success in relation to other habitat parameters such as distance to water, edge, shelterbelt, other nests, and general habitat type.

Results:

The second year of field work at Freezeout began on 20 April and continued through 30 July 1992. A broad variety of nesting habitats were examined including native prairie, planted dense nesting cover, and wetland vegetation. A total of 382 duck nests were located despite dry conditions that prevented early vegetation growth. Teal (blue-winged and cinnamon) and gadwall were the predominant species in uplands at Freezeout Lake and comprised 37% and 34%, respectively, of nests found. Few nests of mallards and pintails, two species whose continental populations have been declining since the early 1980's, were located. Overall duck nest success (Mayfield method) was 48%. In addition, 118 nests of other birds, primarily phalaropes and passerines (chestnut-collared longspurs, savannah sparrows, meadowlarks) were discovered in upland fields.

Results were similar to information gathered in 1991. A total of 230 duck nests (31% teal and 27% gadwall), and nests of 30 phalaropes, 20 meadowlarks, 20 passerines, and 24 other species were located. Mayfield nest success for all ducks was 43%.

White-tailed Deer/Forest Relations in North Idaho

Project Leader:	D. Pletscher
Student Investigator:	M. Secord
Cooperators:	Idaho Department of Fish and Game; Kaniksu National Forest

Objectives:

1. Identify, describe, and provide management recommendations for winter range habitats;
2. evaluate logistic regression models developed by Pauley (1990) for predicting white-tailed deer use of timber structural types based on snow depths; and
3. describe the structural and vegetative characteristics of various cutting units in the Priest Lake region, and investigate deer use of these areas during the spring and summer months.

Results:

During the winters of 1991-92 and 1992-93, a total of 29 white-tailed deer were radio-collared at Priest Lake, Idaho. Study animals were monitored on four geographically distinct winter ranges, and 493 radio-locations were recorded. Measures of stand structure and vegetation were taken at these locations, and are being used in defining winter habitat use. Relocations were predominately in mature stands of timber below 920 m in elevation, and south and west aspects were frequently selected. The vast majority of study animals were migratory and spring movements of up to 40 km were documented.

Snow depths were recorded in openings and sites representative of old growth timber, mature timber, and pole timber stand types. In addition, snow depths were recorded at 80 sites representative of actual deer locations. These data will be used in testing models developed by Pauley (1990) for predicting deer use of timber structural types based on snow depths. Observed use is being compared against model predictions and the validity of the models evaluated. Preliminary results have shown model predictions to be erroneous.

A sample of 14 clearcuts was selected at Priest Lake, and spring and summer pellet-group counts carried out during the 1992 field season. The relationship of deer use to the structural and vegetative characteristics of the units is presently being evaluated. Early findings reveal that use declined from spring to summer and was highly variable between units. No correlation was found between unit age and pellet density.

Estimating the Nutritional Quality of Bear Habitat in Southeastern British Columbia by Measuring Bear Body Condition

Project Leader:	C. Servheen
Student Investigator:	D. Reiner
Cooperators:	USFWS; British Columbia Ministry of Forests

Objective:

Measure the nutritional quality of different bear habitats by measuring changes in the body condition (body weight and fat composition) of intensively tracked, radio-collared bears as they use different habitats.

Results:

The student investigator was in the field from 4 May through 31 October 1992. Recapture collars were used on one male black bear, two female black bears, and one female grizzly bear. Various problems were encountered with the recapture collars. The collar on the female grizzly stopped working 10 days after it was put in place; the cause is unknown as the collar has not been retrieved. The other major problem was the failure of collars to reliably indicate whether or not the darts had been fired. On several occasions, the first dart did not drug the animal and the collar did not indicate that the dart had fired. In all cases, it was found that the first dart had fired. Knowing whether or not the first dart has fired is important in deciding whether or not to fire the second dart immediately or later, possibly days later. A total of five recaptures were made using the collars over a 2-month period.

While the recapture collars were used, the collared bears were intensively tracked and habitat plots were conducted to measure the biomass of vegetation in the habitats the collared bears were using.

During late July, August, and September, vegetative plots were conducted in huckleberry fields to document the abundance of berries. The 1992 berry crop was very poor.

In mid-July use of recapture collars was discontinued due to their unreliability. Trapping continued in order to obtain information on the body condition of as many bears as possible. A total of 50 captures were made from May to October, not including captures made using the recapture collars.

Evaluating Biodiversity at the Landscape Level Using a GIS: The Seeley-Swan Valley, Northwestern Montana

Project Leader:	R. Redmond
Student Investigator:	M. Hart
Cooperators:	USFS: Intermountain Research Station; U.S. Fish and Wildlife Service

Objectives:

1. To evaluate deviation from the natural range of vegetative conditions, compare pre-settlement and current landscape characteristics through computer modeling and analysis of landscape structure;
2. to assess landscape diversity, characterize both unique areas and common landscape elements--use gap analysis and representativeness technique to identify gaps in protection of native terrestrial vertebrates, sensitive plant species, and plant communities in general;
3. propose a natural areas network, giving special attention to old growth, unique habitats, and sensitive species; and
4. to aid in future biodiversity assessments, outline a process or formula for evaluations at the landscape level.

Results:

Efforts to date have focused on compiling information from outside sources and field work. During summer 1992, vegetation sampling was conducted throughout the study area to supplement data shared by the Flathead National Forest. Results will be used in the classification and labeling of Landsat TM imagery. This vegetative classification will provide a base GIS layer for future analyses. Currently, other necessary GIS data layers are also being constructed in ARC/INFO, and analysis is scheduled to begin in January 1993.

Evaluation of Bighorn Sheep in the Ten Lakes Scenic Area

Project Leader:	L. Marcum
Student Investigator:	S. Johnsen
Cooperators:	USDA Forest Service, Kootenai National Forest; British Columbia Ministry of Environment, Wildlife Branch; Montana Department of Fish, Wildlife and Parks; Foundation for North American Wild Sheep; East Kootenai Wildlife Association

Objectives:

1. Conduct ground surveys during all seasons of the year to determine abundance, composition, and productivity of the bighorn sheep population;
2. conduct ground surveys during each season to determine habitat use by age and sex groupings;
3. conduct aerial surveys during each season to supplement and confirm ground survey data on population and habitat use;
4. develop records and maps to display population and habitat use data during all seasons of the year; and
5. develop a tentative harvest strategy that would be appropriate to maintain growth of the bighorn sheep population and be complementary to the ongoing management program in British Columbia.

Results:

In this study, bighorn sheep (Ovis canadensis) are observed by ground and aerial surveys, and by tracking nine radio-collared animals (6 ewes and 3 rams) that were trapped in February and March 1992. Through 31 August 1992, 337 observations of 2,352 bighorn sheep were obtained. Based on these observations it was estimated that the population in winter 1992 consisted of a minimum of 51 animals (21 males, 23 females, and 7 lambs). In 1992, the first newborn lamb was observed on 19 May, on St. Clair Peak within the Ten Lakes Scenic Area. Sixteen lambs were observed in the Scenic Area by 11 June. The mean lamb:ewe ratio declined from 91:100 in June 1992 to 62:100 in August 1992.

On the summer range, sheep primarily use the rock cliffs and scree slopes of the Ten Lakes Area. However, they were also observed in subalpine forest habitat on several occasions. Elevations used in summer ranged from 1,951 m to 2,317 m. The herd wintered at elevations of 793-1,677 m, north of the International Border in British Columbia, Canada. The vegetation of the winter range is dominated by several Douglas-fir (Pseudotsuga menziesii) habitat types. Openings within the forst are comprised of bitterbrush (Purshia tridentata)/rough fescue (Festuca scabrella) and bitterbrush/bluebunch wheatgrass (Agropyron spicatum) habitat types. The southern portion of the winter range was logged 5 years ago and currently supports very scattered trees and a variety of undergrowth species. This area also contains a hayfield, and a large rough fescue/bluebunch wheatgrass meadow which the sheep used in January 1992. This meadow is reported to be the area where most rutting activity occurs.

During late April 1992, the sheep began to enlarge their range area. During a flight on 22 May, five of the radio-collared animals were observed with five other bighorn sheep in the Wigwam drainage, 11 km northwest of their winter range. By 11 June, all radio-collared animals were within the Ten Lakes Scenic Area.

Field work will continue through December 1992.

Nest Success of Upland-Nesting Ducks in the Flathead Valley

Project Leader:	J. Ball
Student Investigator:	N. Hall
Cooperators:	USFWS: National Bison Range; Montana Department of Fish, Wildlife and Parks

Objectives:

1. Document nest success and, where possible, causes of nest failure on both removal and nonremoval areas;
2. evaluate costs and benefits of skunk removal;
3. attempt to quantify the relative importance of pair habitat; size, type, and condition of cover; and the presence or absence of predators; and
4. submit management recommendations.

Results:

The student investigator has accepted a position with Washington Water Power and expects to complete thesis in 1993.

The Effects of Human Development on Grizzly Bear Movement and Distribution in the North Fork of the Flathead River, Montana

Project Leader:	C. Servheen
Student Investigator:	N. Kehoe
Cooperator:	USFWS: Grizzly Bear Recovery Coordinator

Objectives:

1. Determine the relationship between the combined effects of human developments, presence of hiding cover, open road density, and wetlands/riparian areas on grizzly bear movements across and within the North Fork of the Flathead River Valley between Polebridge and the Canadian border;
2. determine threshold values for the four individual habitat components, or combinations of components, which precludes use of that habitat by grizzly bears;
3. determine the relationship between human use and development and grizzly bear activity patterns;
4. collect information on whether portions of the North Fork Valley act as demographic sinks;
5. determine kind, timing, and periodicity of grizzly bear movements in the valley bottom; and
6. refine the LZP model if necessary to more accurately reflect grizzly bear movements with respect to the four habitat components.

Results:

A Geographic Information System is being used to predict potential grizzly bear linkage zones in the North Fork Valley. A linear arrangement of past and current human activities and development in the valley bottom have resulted in a fracture zone, where fragmentation of existing bear populations is in progress. Concern has been expressed over the effect this fracture zone may have on grizzly bear movements between Glacier National Park to the east and the Whitefish Range to the west.

The Linkage Zone Prediction (LZP) model was developed by USFWS in an effort to assess the human activities known or thought to have a significant effect on grizzly bear movement and occupancy of habitat. This is the first known attempt to simultaneously evaluate four habitat factors, facilitating the prediction of movement patterns and identification of areas with linkage zone potential

There are currently approximately 14 grizzly bears with active radiocollars in the North Fork area. An additional 5-10 grizzly bears will be trapped in late spring and fitted with activity sensing radiocollars. Ground and aerial radiotelemetry will be used to monitor grizzly bear movements in the river bottom area of the North Fork beginning in May or June 1993 and continuing until fall.

The student is currently enrolled in classes.

Development of a Conservation Plan for the Bears in the Rhodopi Mountains

Project Leader:	C. Servheen
Student Investigator:	G. Giannatos
Cooperators:	World Society for the Protection of Animals; Ministry of Agriculture (Greece); WWF--Greece

Objectives:

Development of a management plan integrating human use and bear needs on habitat and populations management.

The following methods will be used:

1. survey of people use (maps, demographic data, land uses, changes in population and land uses in recent years); and
2. survey bear distribution--historic records, recent records, sightings, conflicts, illegal kills, etc.

Results:

The student investigator is currently enrolled in classes. In July 1993 he will be sent into the Rhodopi Mountains to collect data. The final output will consist of a management plan outlining needs for bear conservation and will be the guiding plan for bear conservation in the Rhodopi Mountains.

SPECIAL PROJECTS

Physiologic and Ecological Studies of the Pronghorn (Antilocapra americana)

Project Leader:	B. O'Gara
Cooperators:	USFWS: National Bison Range; Montana Department of Fish, Wildlife and Parks; and the Wildlife Management Institute

Objectives:

To study:

1. the reproductive physiology of male and female pronghorn;
2. the physiology and function of scent glands;
3. food habits related to changes in range conditions;
4. horn growth and casting; and
5. the relationships of pronghorns to other artiodactyls.

Results:

The pronghorn book is being edited and should be published in late 1993 or early 1994.

Mammals of Taiwan: Biology and Conservation

Project Leader:	R. Taber
Collaborator:	Antoon de Vos
Cooperators:	Pacific Cultural Foundation (Taiwan) USFWS: Montana Cooperative Wildlife Research Unit

Objectives:

To prepare and illustrate a chronological account of the 65 free-living mammals of Taiwan with emphasis on biology, relations to man, and development of conservation strategies.

Results:

The project began January 1992. A progress report has been accepted. Assistance with publication has been proposed by Pacific Cultural Foundation and the Taipei Zoo. The Council on Agriculture, R.O.C. (responsible for most wildlife affairs) proposes to promote distribution. Relevant literature in Chinese has been translated and preparation of the first draft is well along.

Duck Banding in Canada

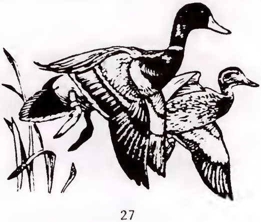
Project Leader:	J. Ball
Students Technicians:	Varies, 3 to 6 annually
Cooperator:	USFWS: Migratory bird Management Office

Objectives:

1. Trap and band 2,000 mallards and up to 1,500 pintails and 1,000 of each of the other species available. This quota will be sought at each of 10 banding stations;
2. maintain accurate records and provide summary reports from each station to the Migratory Bird Management Office;
3. provide students from the Montana Cooperative Wildlife Research Unit with training in waterfowl research techniques and an ecological perspective that can only be obtained through on-the-ground experience; and
4. evaluate distribution of recoveries, recovery rates, and (when possible) survival rates of northern shovelers and gadwalls.

Results:

Vary annually. Detailed annual reports are available. Preliminary analyses of shoveler and gadwall files have been completed.



Identification and Protection of Biodiversity in Montana Using a Geographic Information System

Project Leader:	R. Redmond
Cooperators:	USFWS: Cooperative Research Units Center; IBM Corporation

Objectives:

1. Develop an expert systems model to predict vegetation and land cover classes from Landsat thematic mapper (TM) imagery and biophysical data;
2. use the model to classify and map the state's vegetation and land cover at a scale of 1:250K for uplands and 1:100K for wetlands;
3. predict and map the distributions of native terrestrial vertebrates;
4. map the boundaries of all protected lands in the state according to administrative organization and level of protection;
5. assess accuracy of procedures and products; and
6. conduct GIS analyses to identify vegetation types and areas of high species richness that may lack adequate protection under current land ownership and management regimes.

Results:

Vegetation Mapping. The map of existing vegetaion for Montana is being developed from a digital classification of Landsat-TM data. The general classification process involves two steps: 1) discerning the pattern of spectral polygons and delimiting their boundaries, and 2) labeling the polygons. The first step is accomplished with a classification algorithm developed during the last year that mimicks the false-color composite of TM bands 4, 5, and 3 (RGB). For the second step, ground-truth data from existing vegetation maps, plot data, and aerial photographs are being analyzed with ancillary biophysical data (slope, elevation, aspect, and climate) to determine statistical relationships between polygon attributes and existing cover types. These relationships then will be used as "knowledge" for an expert system to predict the cover type, and associated variables (e.g., age, structure, and canopy cover) for the remaining, unlabeled spectral polygons within a given TM scene.

The efficacy of this process is still being evaluated on two pilot study areas: the Seeley-Swan Valley in western Montana, and a portion of the Charles M. Russell (CMR) National Wildlife Refuge in the east-central part of the state. These areas were selected because a considerable amount of vegetation data was available for each, and because each area contains vegetation that is generally representative of much larger surrounding areas. Results from the Seeley-Swan Valley indicate that relatively pure forest types, such as ponderosa pine, Douglas fir, western larch, and lodgepole pine can be readily distinguished, but as stands become mixed, species composition becomes more difficult to identify. To further complicate matters, class definitions for published vegetation hierarchies (e.g., UNESCO, SAF, USGS) often do not match the attributes of our spectral classification. Consequently, we are working closely with a group of botanists and plant ecologists across the state to develop a revised classification of existing vegetation and to advise with the mapping process.

As of October 1992, 22 of the 31 TM scenes covering the state have been acquired, and four have been classified to delimit spectral polygons. Also, all Defense Mapping Agency (1:250K) digital elevation models for the state have been acquired, and we have ordered the USGS Digital Line Graphs (1:100K) for hydrography. This layer will be critical for the accurate mapping of riparian vegetation and associated animal species. Average annual precipitation and temperature variables are being produced from long-term weather data and a computer model. The weather data are complete for the Seeley-Swan Valley, but the computer models need to be revised for the relatively flatter, eastern portion of the state.

Animal Distributions. An advisory group consisting of wildlife ecologists from agencies and universities has been formed to guide efforts to model the distributions of the state's 410 native terrestrial vertebrates. The Montana Natural Heritage Program is providing the Vertebrate Characterization Abstracts for these species. Biologists from the Forest Service and the Department of Fish, Wildlife and Parks have provided input for us to model distributions of upland game birds, big game, and furbearers in the Seeley-Swan pilot study area. These predicted distributions soon will be compared with existing maps of known distributions to evaluate the modeling techniques.

Land Ownership/Management. Negotiations are in progress with the BLM to share the costs of scanning, editing, and labeling their 1:100K Surface and Subsurface Management Series maps for Montana. Because many cooperating agencies were not satisfied with the four general classes of protection used by the Gap Analysis Program, we are working with the Montana Interagency Natural Areas Committee to develop a more detailed classification of management and protection categories for all lands in the state. These classes will not replace the four levels used for Gap Analysis, but will be added as another attribute in the database.

Human Activities and Linkage Zones for Grizzly Bears and Other Large Carnivores

Project Leader:	C. Servheen
Research Associate:	P. Sandstrom
Cooperators:	U.S. Fish and Wildlife Service; University of Montana; Flathead National Forest; Lolo National Forest; Confederated Salish and Kootenai Tribes; Montana Department of State Lands; Montana Department of Fish, Wildlife and Parks; Plum Creek Timber Company; Missoula, Lake, and Flathead counties

Objectives:

1. Using a Geographical Information System (GIS) and satellite data, develop a technique to assess the effects human activities have on grizzly bear movements; and
2. after methods are refined, apply them within and between all grizzly bear recovery areas to evaluate where possible linkage zones still exist.

Results:

The Seeley-Swan Valley was selected as a pilot study area. Human activities in the Valley are threatening to isolate the grizzly bear population in the Mission Mountains from the larger population in the Bob Marshall/Glacier complex. If the current trend of human development continues, the Mission Mountain grizzly bear population is expected to be extinct in 20 years. To insure the continued existence of grizzly bears and other large carnivores in the Mission Mountains, linkage zones across the valley bottom must be maintained.

Existing digital geographic information for the area has been imported into the University of Montana's Wildlife Spatial Analysis computer system. For the linkage zone analysis the following four layers have been developed:

1. Open road densities layer; calculated using the moving circle analysis method.
2. Hiding cover/nonhiding cover layer; developed from a LANDSAT satellite image and forest stand information.
3. Human influence layer; displaying residences, campgrounds, livestock operations, etc. with assigned influence zones and buffers.
4. Riparian layer; serving as the basic habitat layer where riparian areas in general provides more foods and facilitates travel.

Different scores were assigned to each category within each layer. The scores were then summed, creating a map where each pixel has a value displaying the cumulative effect of the human activities at that point. This map and the satellite image were used as a base from which boundaries are delineated for possible linkage areas across the Seeley/Swan Valley.

The mixed ownership pattern of the Seeley/Swan Valley has made management of linkage areas across the valley difficult. Part of our effort is to bring together the different agencies and landowners to cooperatively develop a conservation strategy for the valley with management emphasis on linkage areas. Meetings to carry out this task are currently under way.

The same effort carried out in the Seeley/Swan is now initiated in the North and Middle Forks of the Flathead River valleys. Later this year possible linkage zones between the Cabinet/Yaak and the Selway/Bitterroot ecosystems will be evaluated.

CONSERVATION, EDUCATION, AND PUBLIC RELATIONS

Bart O'Gara, Unit Leader (10/1/91-6/30/92)

October-June	Served on University of Montana Asian Studies Committee.
October-September	Served on Department of Agriculture National Animal Damage Control Advisory Committee.
18 October	Met with FWP and Rocky Mountain Elk Foundation biologists to plan public meeting concerning preservation of elk habitat in the Missoula Valley.
6 November	Presented a 3-hour, slide-assisted lecture on capture and immobilization of large mammals to advanced wildlife conservation class (about 40 seniors and graduate students).
20 November	Presented a 3-hour, slide-assisted lecture on field necropsies to advanced wildlife conservation class (about 40 seniors and graduate students).
9 December	Attended meeting at Rocky Mountain Elk Foundation Headquarters regarding conservation easements on elk winter range.
10 December	Spent half day at National Bison Range training manager and crew in use of dart gun and drugs.
6-10 January	Took Professor Chou of the Plateau Institute of Biology, Qinghai, China, around Montana to show him wildlife management practices.
13 January	Gave a 1-hour, slide-assisted lecture to Student Chapter of the Wildlife Society on pronghorn behavior and management (about 90 students and general public).
4-7 February	Attended Montana Chapter of The Wildlife Society meetings in Whitefish, Mont. Presented slide-assisted lecture on wildlife management, or lack of it, in western China.
10 February	Reviewed 30-page manuscript for Proceedings of the Eastern Animal Damage Control Workshop.
2 March	Presented a 1-hour, slide-assisted lecture on African and Asian parks to parks management class (37 students).

23 March	Attended meeting of Ravalli County Sportsmen Association in Hamilton, Mont., and discussed deer study on the Metcalf National Wildlife Refuge (38 sportsmen).
21 April	Presented slide-assisted lecture comparing attitudes toward wildlife in China and the United States to the Mansfield Forum (about 80 University and townspeople).
21 April	Lectured to University of Montana wildlife management issues class, "Predation by wildlife on livestock and pronghorn antelope."
9-11 June	Attended Pronghorn Workshop in Rock Springs, Wyo., and presented management guidelines manuscript for approval by the attendees.
21-24 September	Participated in meeting of the National Animal Damage Control Advisory Committee in Fort Collins, Colo.

Joe Ball, Assistant Unit Leader (10/1/91-6/30/92)
Unit Leader (7/1/92-9/30/92)

October-December	Taught University of Montana game checking station class (45 students).
4 November	Refereed 29-page manuscript for the Wildlife Society Bulletin.
11-12 November	Hosted and organized lecture and workshop presented by Susan Sheaffer and Richard Malecki on "Analysis of Bird Banding and Mark-Recapture Data."
18 November	Gave presentation to Big Sky Upland Bird Association, Missoula, Mont. Topic: Maximizing populations of waterfowl and upland birds through such efforts as artificial nesting structure and predator management.
18 December	Attended meeting of Prairie Pothole Joint Venture, National Bison Range, Moiese, Mont.
January-March	Taught University of Montana biological writing class (6 students)
14 February	Reviewed 76-page manuscript for USFWS-FWE.
28 February	Reviewed and commented on 21-page manuscript for other waterfowl biologists.

April-June	Taught University of Montana class, hunting and animal rights (8 students).
1 July	Appointed Acting Unit Leader, Montana Cooperative Wildlife Research Unit.
12 August	Refereed 22-page manuscript for the Wildlife Society Bulletin.
14 August	Refereed 22-page manuscript for the Journal of Wildlife Management.
20 September	Appointed Unit Leader, Montana Cooperative Wildlife Research Unit.

Dan Pletscher

17 January	Participated in 1992 Annual Wolf Working Group meetings in Whitefish, Mont.
23 February	Moderated a panel on Human Attitudes Toward Bears at the International Bear Conference in Missoula, Mont.
29 March	Participated on the Board of Directors in a meeting in Charlotte, N.C. for the International Wildlife Management Congress to be held in Costa Rica.
6 & 8 April	Presented information on forestry and biodiversity at a continuing education class , University of Montana.
7 April	Participant in a national teleconference on "Wildlife conservation and the hunting tradition," a debate televised from The University of Montana campus.
6 August	Represented The University of Montana in the renewal of our Sister Institution Agreement with the Northwest Plateau Institute of Biology in Xining, Qinghai Province, People's Republic of China.
21 September	Demonstrated the use of capture equipment to a group of wildlife biologists in Gansu Province, People's Republic of China.

Salah Hakim

May	Lectured on "Land use conflict and wildlife conservation in Sudan." Sponsored by The Wilderness Institute, Univ. of Montana, Missoula.
May	Talked to Stevensville, Mont. grade school classes on "African Wildlife."

Richard Harris

14 January	Lectured on "Alternative strategies of mammal conservation" to University of Montana mammal conservation class (65 students).
14 April	Lectured on "Wildlife conservation in China," to University of Montana class on wildlife issues.
1 July	Refereed manuscript for Conservation Biology.
26-30 July	Attended 7th International Snow Leopard Symposium in Xining, Qinghai, People's Republic of China. Translated one presentation from Chinese to English.

Melissa Hart

8-11 April	Attended Seventh Annual U.S. Landscape Ecology Symposium, Corvallis, Oreg.
9-14 June	Attended USFS Region 1 Sustaining Ecological Systems Training Session, Missoula, Mont.

Jeff Marks

5 November	Refereed a manuscript for the Canadian Journal of Zoology.
26 February	Presented seminar on "Nonbreeding ecology of bristle-thighed curlews," The University of Montana.
20 May	Refereed a manuscript for the Wilson Bulletin.
7 June	Refereed a manuscript for the American Naturalist.
12 June	Refereed a manuscript for Northwest Science.
4 August	Reviewed the shorebird species accounts for the Neotropical Migratory Bird Handbook, U.S. Forest Service.
15 August	Co-led a Five Valleys Audubon Society field trip to Ninepipe National Wildlife Refuge to view shorebirds.
24 September	Lectured on bird trapping and banding to The University of Montana wildlife techniques class.
29 September	Refereed a manuscript for the Wilson Bulletin.

Daniel Miller

11 October	Presented slide seminar: "Wildlife of the Tibetan Plateau," in Whitefish, Mont. Sponsored by Children for Wildlife and the Flathead Chapter of the Montana Wilderness Association.
16 October	Lectured to University of Montana careers in wildlife class on "International opportunities in wildlife conservation."
6 January	Presented slide seminar: "Integrating livestock development and environmental conservation in upland areas of Asia," in Manila, Philippines. Sponsored by the Asian Development Bank.
31 January	Presented slide seminar: "Forestry development and conservation in the Himalyan Kingdom of Bhutan," in Washington, D.C. Sponsored by The World Bank.
3 February	Presented slide seminar: "Conservation and development on the Tibetan Plateau: opportunities for integrating forests, rangelands, wildlife and livestock," in Washington, D.C. Sponsored by The World Bank.

Alison Perkins

7-12 January	Attended Seventh Annual Arctic Goose Conference, Vallejo, Calif.
4-7 February	Attended Montana Chapter of The Wildlife Society meeting in Whitefish, Mont.
8-11 June	Attended National Irrigation Water Qualify Program Review of the Sun River Irrigation Project, Great Falls, Mont. Presented informal overview of duck production at Freezeout Lake.

Mark Secord

3 February	Lectured on timber harvest and white-tailed deer management at Kootenai Valley Sportsmen's Association, Bonners Ferry, Id.
20 June	Presented USFS Campfire Program on white-tailed deer of northern Idaho, Sullivan Lake, Wash.
3 July	Presented USFS Campfire Program on white-tailed deer research, Priest Lake, Id.

18 July	Lectured on white-tailed deer natural history and research, Lion Head State Park, Priest Lake, Id.
14 August	Lectured on white-tailed deer natural history and research, Indian Creek State Park, Priest Lake, Id.

PAPERS PRESENTED

Ball, I. J. February 1992. Habitat fragmentation and nest predation: emerging parallels between forest and grassland. Montana Chapter, The Wildlife Society, Kalispell, Mont.

Ball, I. J. May 1992. Wetlands and endangered species. National Wildlife Federation's Endangered Species Act Workshop, Missoula, Mont.

Ball, I. J. September 1992. Predators and their impact on nesting birds. Idaho Chapter of Pheasants Forever, Pocatello, Id.

Felley, D. L. April 1992. Reproduction of a southwest Idaho pheasant population. Northwest Section, The Wildlife Society, Moscow, Id.

Felley, D. L. September 1992. Recruitment of pheasants in southwestern Idaho. Idaho Chapter of Pheasants Forever, Pocatello, Id.

Gazda, R. J. July 1992. Current wildlife research at the Sterling Wildlife Management Area. Summer meeting of Southeast Idaho Rod and Gun Club, Pocatello, Id.

Gazda, R. J. September 1992. Nest success of ground-nesting birds at Sterling Wildlife Management Area. Eastern Idaho Pheasant Conference, Pocatello, Id.

Gazda, R. J. September 1992. Waterfowl and pheasant research at the Sterling Wildlife Management Area, 1992. Idaho Chapter of Pheasants Forever, Pocatello, Id.

Hakim, S. A. March 1992. An African conservation philosophy to save the elephant and enhance development. Environmental Issues of Africa Conference, Stillwater, Okla.

Hakim, S. A. May 1992. Land use conflict and wildlife conservation in Africa. Wilderness Institute Lecture Series, The University of Montana, Missoula.

Harris, R. L. July 1992. A note on snow leopards and local people in Nangqian County, Qinghai. Seventh International Snow Leopard Symposium, Xining, Qinghai, China.

Liu, Y. S. April 1992. Conservation problems in China. Wilderness Institute Lecture Series, The University of Montana, Missoula.

Maeder, T. G. April 1992. Comparison of survival and recruitment of local and transplanted pheasants. Northwest Section of The Wildlife Society meeting, Moscow, Id.

Maeder, T. G. August 1992. Comparison of survival and recruitment of local and transplanted pheasants. Pheasants Forever, Pocatello, Id.

Maeder, T. G. September 1992. Recruitment of pheasants in southcentral Idaho. Idaho Chapter of Pheasants Forever, Pocatello, Id.

Miller, D. J. October 1991. Wildlife of Tibet. Montana Wilderness Association, Whitefish, Mont.

Miller, D. J. February 1992. From open range to fences: changes in the range-livestock industry on the Tibetan Plateau and implications for development planning and wildlife conservation. 1992 International Rangeland Development Symposium, Spokane, Wash. (Held in conjunction with the annual meeting of the Society for Range Management.)

Miller, D. J. April 1992. Wildlife on the Tibetan Plateau of China--opportunities for conservation and development. Woodlands Mountain Institute Workshop, Kathmandu, Nepal.

Miller, D. J. July 1992. Livestock and snow leopards: making room for competing users on the Tibetan Plateau. Seventh International Snow Leopard Symposium, Xining, Qinghai Province, China.

O'Gara, B. W. January 1992. Pronghorn behavior and management. Student Chapter, The Wildlife Society, Missoula, Mont.

O'Gara, B. W. February 1992. Wildlife management, or lack of it, in western China. Montana Chapter, The Wildlife Society, Whitefish, Mont.

O'Gara, B. W. April 1992. Comparison of attitudes toward wildlife in China and the United States. The Mansfield Forum, The University of Montana, Missoula.

Pletscher, D. H. February 1992. Leopold's land ethic and land aesthetic. 30th Annual Montana Chapter, The Wildlife Society, Whitefish, Mont.

Pletscher, D. H. April 1992. Wolves. Project Wild Teachers Conference, Rocky Mountain Elk Foundation, Missoula, Mont.

Pletscher, D. H. May 1992. Wolves. Endangered Species Workshop, National Bison Range, Moiese, Mont.

Rachael, J. S. January 1992. Mortality of white-tailed deer in an area recolonized by wolves. Wolf Working Group Committee meetings, Whitefish, Mont.

Rachael, J. S. July 1992. Mortality of white-tailed deer in an area recolonized by wolves. Border Grizzly/Wolf Technical Committee meetings, Polebridge, Mont.

Redmond, R. L. November 1991. The Montana biodiversity/Gap analysis project. Montana Natural Areas Conference, Missoula, Mont.

Redmond, R. L. December 1991. Identification and protection of biodiversity in Montana using a GIS. Fourth Annual Montana GIS Conference, Bozeman, Mont.

Redmond, R. L. April 1992. A networked distributed cooperative computational environment. Information Technologies on the Frontiers of Learning, Missoula, Mont.

Redmond, R. L. August 1992. The Montana biodiversity/GAP analysis project. Montana Department of Fish, Wildlife and Parks Annual Wildlife Division Meeting, Fairmont Hot Springs, Montana.

Redmond, R. L. September 1992. Using remote sensing to inventory and protect biodiversity. Sixth Annual INEL Computing Symposium, Idaho Falls, Id.

Reiner, D. C. February 1992. The evolution of bears. Ninth International Conference on Bear Research and Management, Missoula, Mont.

Secord, M. L. October 1991. Ecology of white-tailed deer in the Priest River drainage, north Idaho. Idaho Fish and Game Project Wild Conference, Clark Fork, Id.

Secord, M. L. November 1991. White-tailed deer research techniques and results. Idaho Fish and Game Project Wild Conference, Clark Fork, Id.

Sheldon, A. L. May 1992. Assisted invasions and their consequences in a species-poor western river system. North American Benthological Society, Louisville, Ky.

PUBLICATIONS

Ball, I. J. 1992. Review of: Terborgh, J. Where have all the birds gone? Essays on the biology and conservation of birds that migrate to the American Tropics. J. Wildl. Manage. 56(2):408-409.

Betts, B. J., and D. A. Jenni. 1991. Time budgets and the adaptiveness of polyandry in northern jacanas. Wilson Bull. 103:578-597.

Dhungel, S. K., and B. W. O'Gara. 1991. Ecology of the hog deer in Royal Chitwan National Park, Nepal. Wildl. Monogr. 119:1-40.

Edge, W. D., and C. L. Marcum. 1991. Topography ameliorates the effects of roads and human disturbance on elk. Pages 132-137 in A. B. Ehristensen, L.J. Lyon, and T. N. Lonner, compilers, Proceedings of the Elk Vulnerability Symposium, Montana State University, Bozeman. 330 pp.

Gazda, R. J., and J. W. Connelly. 1992. Nest success of ground-nesting birds at Sterling Wildlife Management Area. Idaho Dep. Fish and Game, Proj. W-16-R-15, Job Prog. Rep. 28 pp.

Gazda, R. J. 1992. Skunks, magpies do most damage to nesting ducks near Sterling. Idaho State Journal, Pocatello, 9/17/92.

Gill, R. E., Jr., and R. L. Redmond. 1992. Distribution, numbers, and habitat of bristle-thighed curlews (Numenius tahitiensis) on Rangiroa Atoll. Notornis 39:17-26.

Harris, R. B. 1991. Conservation prospects for musk deer and other wildlife in southern Qinghai, China. Mt. Res. and Dev. 11(4):353-358.

Harris, R. B., and L. H. Metzgar. 1992. Using both theory and simulation to gain insight: an example using reproductive values. Eastern Workshop on Black Bear Res. and Manage. 10:145-151.

Harris, R. B., and B. W. O'Gara. 1992. Line transects for estimating density of musk deer pellet groups. Acta Theriologica Sinica 12(4):302-305. (In Chinese)

Hass, C. C., and D. A. Jenni. 1991. Structure and ontogeny of dominance relationships among bighorn rams. Canadian J. Zool. 69:471-476.

Hillis, J. M., M. J. Thompson, J. E. Canfield, L. J. Lyon, C. L. Marcum, P. M. Dolan, and D. W. McCleerey. 1991. Defining elk security: the Hillis paradigm. Pages 38-43 in A. G. Christensen, L. J. Lyon, and T. N. Lonner, compilers. Proceedings of the Elk Vulnerability Symposium, Montana State University, Bozeman. 330 pp.

Loggers, C. O., M. Thevenot, and S. Aulagnier. 1992. Status and distribution of Moroccan wild ungulates. Biol. Conserv. 59:9-18.

Marcum, C. L., and W. D. Edge. 1991. Sexual differences in distribution of elk relative to roads and logged areas in western Montana. Pages 142-148 in A. G. Christensen, L. J. Lyon, and T. N. Lonner, compilers, Proceedings of the Elk Vulnerability Symposium, Montana State University, Bozeman. 330 pp.

Marks, J. S. 1992. Longevity record for the bristle-thighed curlew: an extension. J. Field Ornithol. 63:309-310.

Matchett, M. R., and B. W. O'Gara. 1991. Golden eagles and the livestock industry: an emotionally charged issue. Western Wildlands 17(1):18-24.

Miller, D. J. 1992. Wild yaks of Kunlun. Himal 5(3):35-36.

O'Gara, B. W., and J. D. Yoakum, eds. 1992. Pronghorn management guides. Pronghorn Antelope Workshop, Rock Springs, Wyo. 101 pp.

Pletscher, D. H., and R. L. Hutto. 1991. Wildlife management and the maintenance of biological diversity. Western Wildlands 17(3):8-12.

Pletscher, D. H., and C. L. Marcum. 1992. Obituary, W. Les Pengelly, 1918-1991. Wildl. Soc. Bull. 20(1):119-122.

Rachael, J. S., D. H. Pletscher, and C. L. Marcum. 1992. Procedures for minimizing bear/human conflicts while investigating ungulate mortality in northwestern Montana. Montana Forest and Conservation Experiment Station, School of Forestry, Univ. Montana, Missoula. Res. Note 25:1-3.